WATER SUPPLY OUTLOOK
and
FEDERAL - STATE - PRIVATE COOPERATIVE SNOW SURVEYS
for
WESTERN UNITED STATES
Including Columbia River Drainage in Canada

UNITED STATES DEPARTMENT of AGRICULTURE···SOIL CONSERVATION SERVICE
Collaborating with
CALIFORNIA DEPARTMENT of WATER RESOURCES
and
BRITISH COLUMBIA DEPARTMENT of
LANDS, FORESTS and WATER RESOURCES

AS OF
MAR. 1, 1964

UNITED STATES DEPARTMENT OF AGRICULTURE - SOIL CONSERVATION SERVICE

To Recipients of Water Supply Outlook Reports:

The climate of the cultivated and populated areas of the West is characterized by relatively dry summer months. Such precipitation as occurs falls mostly in the winter and early spring months when it is of little immediate benefit to growing crops. Most of this precipitation falls as mountain snow which stays on the ground for months, melting later to sustain streamflow during the period of greatest demand during late spring and summer. Thus, nature provides in mountain snow an imposing water storage facility.

The amount of water stored in mountain snow varies from place to place as well as from year to year and accordingly, so does the runoff of the streams. The best seasonal management of variable western water supplies results from advance estimates of the streamflow.

A snow survey consists of a series of about ten samples taken with specially designed snow sampling equipment along a permanently marked line, up to 1000 feet in length, called a snow course. The use of snow sampling equipment provides snow depth and water equivalent values for each sampling point. The average of these values is reported as the snow survey measurement for a snow course.

Snow surveys are made monthly or semi-monthly beginning in January or February and continue through the snow season until April, May or June. Currently more than 1400 western snow courses are measured each year. These measurements furnish the key data for water supply forecasts.

Streamflow forecasts are obtained by a comparison of total or maximum snow accumulation, as measured by snow water equivalent, to the subsequent spring and summer or snowmelt season runoff over a period of years. The snow water equivalent measured in selected snow courses provides most of the index to the streamflow forecast for the following season. More accurate forecasts are usually obtained when other factors such as soil moisture, base flow and spring precipitation are considered and included in the forecast procedure. Early season forecasts assume average climatic conditions through the snowmelt season.

Listed below are the Federal-State-Private Cooperative Snow Survey and Water Supply Forecast reports available for the West which contain detailed information on snow survey measurements, streamflow forecasts, reservoir storage, soil moisture and other guide data to water management and conservation decisions. Soil Conservation Service Reports may be secured from Water Supply Forecasting Unit, Soil Conservation Service, P.O. Box 2807, Portland, Oregon 97208.

PUBLISHED BY SOIL CONSERVATION SERVICE

REPORTS	ISSUED	LOCATION	COOPERATING WITH
RIVER BASINS			
WESTERN UNITED STATES	MONTHLY (FEB.-MAY)	PORTLAND, OREGON	ALL COOPERATORS
BASIC DATA SUMMARY	OCTOBER 1	PORTLAND, OREGON	ALL COOPERATORS
STATES			
ALASKA	MONTHLY (MAR.-MAY)	PALMER, ALASKA	ALASKA S.C.D.
ARIZONA	SEMI-MONTHLY (JAN.15 - APR.1)	PHOENIX, ARIZONA	SALT R. VALLEY WATER USERS ASSOC. ARIZ. AGR. EXP. STATION
COLORADO AND NEW MEXICO	MONTHLY (FEB.-MAY)	FORT COLLINS, COLORADO	COLO. STATE UNIVERSITY COLO. STATE ENGINEER N. MEX. STATE ENGINEER
IDAHO	MONTHLY (JAN.-JUNE)	BOISE, IDAHO	IDAHO STATE RECLAMATION ENGINEER
MONTANA	MONTHLY (JAN.-JUNE)	BOZEMAN, MONTANA	MONT. AGR. EXP. STATION
NEVADA	MONTHLY (JAN.-MAY)	RENO, NEVADA	NEVADA DEPT. OF CONSERVATION AND NATURAL RESOURCES - DIVISION OF WATER RESOURCES
OREGON	MONTHLY (JAN.-JUNE)	PORTLAND, OREGON	OREG. STATE UNIVERSITY OREGON STATE ENGINEER
UTAH	MONTHLY (JAN.-JUNE)	SALT LAKE CITY, UTAH	UTAH STATE ENGINEER
WASHINGTON	MONTHLY (FEB.-JUNE)	SPOKANE, WASHINGTON	WN. STATE DEPT. OF CONSERVATION
WYOMING	MONTHLY (FEB.-JUNE)	CASPER, WYOMING	WYOMING STATE ENGINEER

PUBLISHED BY OTHER AGENCIES

REPORTS	ISSUED	AGENCY
BRITISH COLUMBIA	MONTHLY (FEB.-JUNE)	WATER RESOURCES SERVICE, DEPT. OF LANDS, FOREST AND WATER RESOURCES, PARLIAMENT BLDG., VICTORIA, B.C., CANADA
CALIFORNIA	MONTHLY (FEB.-MAY)	CALIF. DEPT. OF WATER RESOURCES, P.O. BOX 388, SACRAMENTO, CALIF.

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WATER SUPPLY OUTLOOK
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FEDERAL - STATE - PRIVATE COOPERATIVE SNOW SURVEYS
for
WESTERN UNITED STATES
Including Columbia River Drainage in Canada

ISSUED

MARCH 1, 1964

The Soil Conservation Service coordinates snow surveys conducted by its staff and many cooperators, including the Bureau of Reclamation, Corps of Engineers, Forest Service, National Park Service, Geological Survey, and other Federal Agencies, Departments of State Government, Irrigation Districts, Power Companies, and others.

The Department of Water Resources coordinates snow surveys in California.

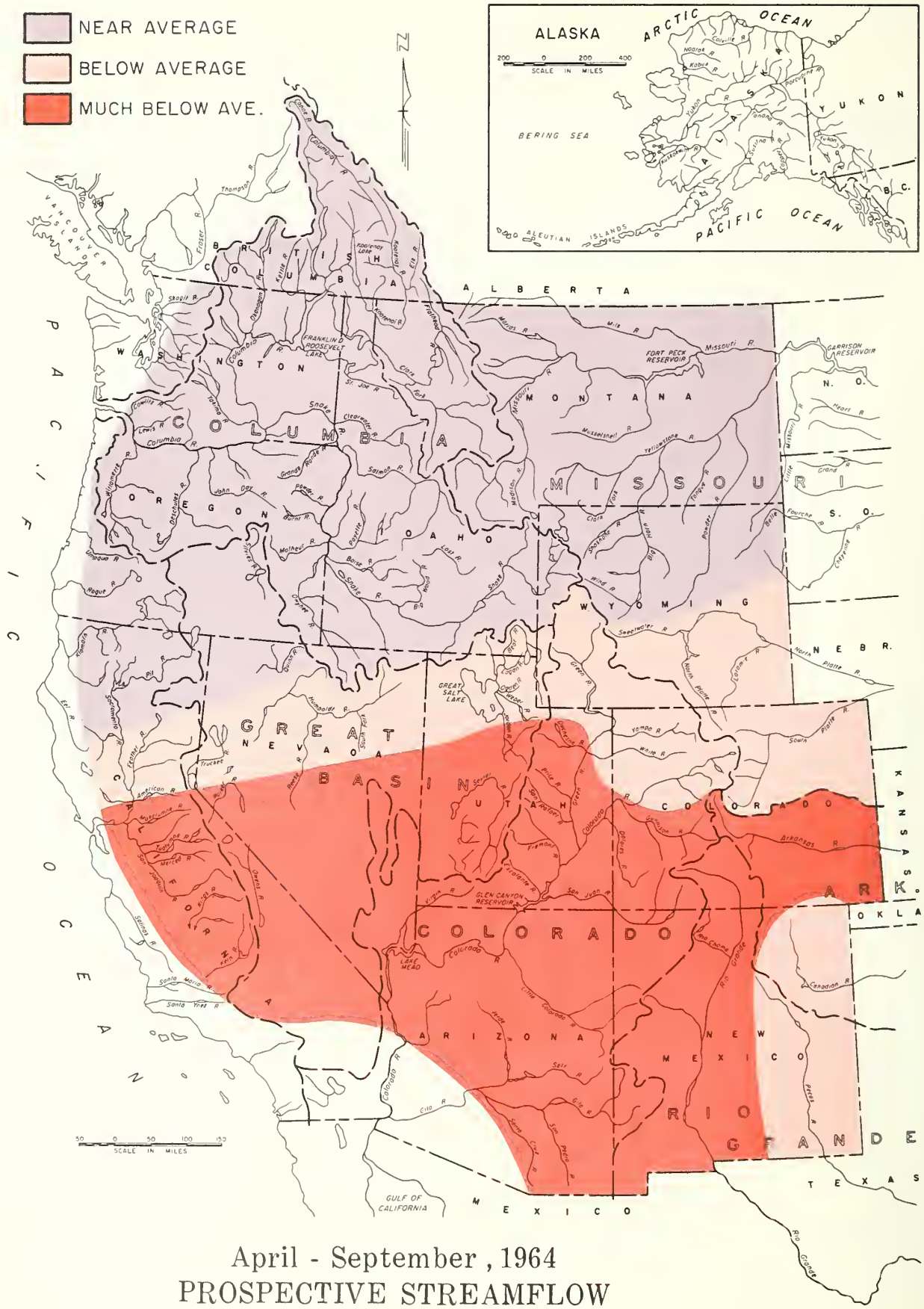
The Water Resources Service, Department of Lands, Forests, and Water Resources directs snow surveys in British Columbia.

This report was prepared by Homer J. Stockwell, under the direction of R. A. Work, Head, Water Supply Forecast Unit, Engineering Division, Soil Conservation Service, Portland, Oregon, from data supplied by Snow Survey Supervisors of the Soil Conservation Service: Arizona, Richard W. Enz; Colorado and New Mexico, Jack N. Washichek; Idaho, M. W. Nelson; Montana, Phil E. Farnes; Nevada, Manes Barton; Oregon, W. T. Frost; Utah, Gregory L. Pearson; Washington, Robert T. Davis; Wyoming, George W. Peak.

California....Dept. of Water Resources, V. H. Lemons, Chief, Water Supply Forecast and Snow Surveys Unit.

British Columbia....Dept. of Lands, Forests, and Water Resources, Harry I. Hunter, Meteorologist, Water Resources Service.

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
D. A. WILLIAMS, ADMINISTRATOR



April - September , 1964
PROSPECTIVE STREAMFLOW
as of March 1, 1964

WATER SUPPLY OUTLOOK
as of March 1, 1964

WATER SUPPLY OUTLOOK FOR WESTERN IRRIGATED AREAS RANGES FROM NEAR AVERAGE IN THE PACIFIC NORTHWEST TO A SEVERE SHORTAGE IN LARGE AREAS OF THE SOUTHERN ROCKY MOUNTAINS AND THE COLORADO RIVER BASIN. LACK OF FEBRUARY PRECIPITATION RESULTED IN A SUBSTANTIAL DECLINE IN OUTLOOK FOR CALIFORNIA CENTRAL VALLEY.

As of March 1, irrigation water supply outlook varies from favorable in the west coast states, including the northern half of the Central Valley of California, Idaho and western Nevada to substantial shortages on the Arkansas and Rio Grande. Snowpack on the source areas of the upper Colorado River and its tributaries in Utah and Arizona is much below average for this date. Most extreme shortages from an irrigation and other consumptive use standpoint are in prospect for the Arkansas, Rio Grande, and southern Utah both in the Colorado and Interior basin areas.

In general, water supply outlook tended to decrease during the month of February. Streamflow forecasts decreased in the range from five to fifteen percent of average. Snowfall over the West was deficient in most areas during the month, including those areas of the Northwest where outlook remains favorable. Much of the seasonal snowfall occurred during January.

For the Pacific Northwest and California, snowpack is far in excess of that measured on March 1, 1963. Heavy snowfall after late March a year ago, which persisted through early June, resulted in a good water supply in west coast states which was not anticipated from early season snowfall. The improvement in late season extended to Nevada and Utah. That late season improvement in water outlook was an extreme departure from the normal weather sequence of the spring months.

Due to the lack of February precipitation, snowpack and streamflow prospects in Utah, Colorado, New Mexico and Arizona are, for practical purposes, comparable to a year ago. Extreme shortages are again to be expected with little chance for complete alleviation in late season.

Some degree of water shortage would occur this summer east of the Continental Divide in Montana and Wyoming for irrigated areas that are not immediately along the Missouri, Yellowstone, Bighorn and their principal tributaries. Outlook along the North Platte and South Platte is only fair.

If snowfall for the remainder of the season is near or above average, water supplies for irrigated areas of the Columbia Basin will be adequate to meet usual demands. Should the February pattern of snow accumulation persist, there could be some degree of shortage for some of the smaller irrigated areas of central and eastern Oregon and Snake River tributaries in central Idaho.

The water situation for California's Central Valley suffered a setback by one of the driest Februarys of record, according to the California Department of Water Resources. Reservoir storage remains good and is average for this date. Snowpack for March 1 is down, with the average for the central and southern Sierras 65 and 55 percent respectively. The distribution of the snowpack ranges from an average of 70 percent in the Feather River Basin to 35 percent of average in the Kern River Basin. The dry February increased southern California's dependence upon imported water supplies.

Storage in irrigation reservoirs of the West tends to be less than average for this date and a year ago. Shortages are most substantial in southern Wyoming, Colorado, New Mexico and Arizona.

MISSOURI BASIN

February snowfall was near average over the headwaters of the Missouri and its tributaries from northern Montana to the South Platte of Colorado. For March 1, snowpack measurements are in the 60 to 110 percent range, with the greatest deficiency on the North and South Platte. If the seasonal pattern to date continues, there will be limited shortages along the smaller tributaries to the Bighorn and Tongue rivers, and less than adequate water supplies in the heavy use areas along the North and South Platte.

MONTANA

Snow accumulation to date on the upper Missouri tributaries above Three Forks and on the headwaters of the Yellowstone is about 90 percent of average for March 1. A limited

area of above average snowfall has occurred on the northern tributaries of the Missouri but declines again on the headwaters of the Marias and Milk rivers. Storage in reservoirs on the principal streams is near average and comparable to a year ago.

Irrigation water supplies are expected to be generally adequate. If the late season snowfall is substantially less than average, shortages could occur on the Milk and Marias rivers, and on Rock Creek and Red Lodge Creek, tributaries to the Yellowstone.

Mountain soils tend to be dry under the snowpack. Storage in irrigation reservoirs is well below average and a year ago on this date.

WYOMING

Water supply outlook declined during February because of limited snowfall at most mountain elevations. Streamflow forecasts range from about 65 percent of average on the North Platte to 85 percent on the upper Snake. Storage in irrigation reservoirs is less than average. However, the combination of storage and prospective streamflow is expected to provide enough water to meet average demands in the major irrigated areas along the Wind, Bighorn and North Platte. On the Laramie, with limited storage and less than an average streamflow forecast, shortage of water is indicated.

February precipitation has been deficient except for a narrow belt, north to south, through the center of the state.

COLORADO (South Platte)

Snow accumulation to March 1 is near the minimum of record for the South Platte drainage, and slightly less than for a year ago. Unless there is a reversal in the snow accumulation pattern for the remainder of the season, streamflow in 1964 will be comparable to, possibly less than for 1963. Carryover storage in irrigation, municipal and Colorado-Big Thompson reservoirs is less than average, and much less than for a year ago. The general outlook is considered as only fair, with water supplies to be well below usual demands for irrigation. Much of the total supply will be available from Colorado-Big Thompson in the northern tributaries and the lower South Platte.

ARKANSAS BASIN

The outlook for irrigation water along the Arkansas and its tributaries in Colorado and western Kansas is poor. Snowpack is 65 percent of average for March 1, a decline during February, and less than for this date a year ago. Storage for the 1964 season is almost nonexistent. Moisture in the plains area soils has also declined during the past month and is now average to poor.

There was some improvement on the headwaters of the Canadian in New Mexico during March, with snow accumulation now near average for this date. Storage in Conchas Reservoir for the Tucumcari project is less than half of average and a year ago.

RIO GRANDE BASIN

Snowfall to date on the headwaters of the Rio Grande in Colorado is only 45 percent of average and 60 percent of that for March 1, 1963. Most snow courses have a minimum of record measurement for March 1. As of now, an extremely short water year along the Rio Grande and its tributaries is a practical certainty. Streamflow less than for the short year of 1963 is most probable. Most water will have to come from groundwater sources.

Adding to the poor outlook is the almost complete lack of carryover storage in reservoirs. Storage is just nominally above the minimum of record.

The extreme shortage does not apply to the Pecos, but here also, surface water supplies will probably total much less than average and for the past few years, when water supplies have been relatively good.

COLORADO BASIN

The flow of the Colorado River and its tributaries during the snowmelt season of 1964 is expected to be only slightly greater than for the extremely low 1963 season. Increase in snowpack during February was negligible in practically all areas of the basin from the Rockies to the Colorado-Great Basin Divide. Total snow for the season to date is much less than average and comparable to or less than that of March 1 a year ago, except for the Green River in Wyoming and its tributaries in Colorado. Inflow to Lake Powell is forecast at 5,200,000 acre-feet for the April-September period, or about 57 percent of average.

COLORADO

Snow accumulation to date is much less than average in western Colorado with extreme deficiencies in all areas except for the headwaters of the Yampa and White rivers. With an advancing season and a decline in water supply outlook, some shortage can be anticipated along all but the main streams and particularly on the Dolores and Pine rivers and smaller tributaries to the San Juan. Storage in irrigation reservoirs is less than average. Most

SUMMARY OF SNOW WATER EQUIVALENT MEASUREMENTS MARCH 1, 1964

MAJOR BASIN AND SUB—WATERSHED	WATER EQUIVALENT IN PERCENT OF: LAST YEAR	AVERAGE
MISSOURI BASIN		
Jefferson	126	91
Madison	143	81
Gallatin	118	110
Missouri Main Stem	153	122
Yellowstone	113	91
Shoshone	103	80
Wind	79	67
North Platte	97	78
South Platte	79	67
ARKANSAS BASIN		
Arkansas	86	64
Canadian	92	82
RIO GRANDE BASIN		
Rio Grande (Colo.)	58	45
Rio Grande above Otowi Bridge	65	59
Pecos	63	98
COLORADO BASIN		
Green (Wyo.)	98	70
Yampa - White	103	79
Duchesne	90	50
Price	91	43
Upper Colorado	96	68
Gunnison	90	78
San Juan	59	45
Dolores	60	54
Virgin	220	31
Gila	65	34
Salt	120	39
GREAT BASIN		
Bear	107	75
Logan	150	76
Ogden	279	71
Weber	111	58
Provo - Utah Lake	180	63
Jordan	128	64
Sevier	122	58
Walker - Carson	72	55
Tahoe - Truckee		65
Humboldt	257	81
Lake Co. (Oregon)		92
Harney Basin (Oregon)		86
UPPER COLUMBIA BASIN		
Columbia (Canada)	124	111
Kootenai	134	88
Clark Fork	124	99
Bitterroot	160	97
Flathead	132	93
Spokane	214	105
Okanogan	183	104
Methow	173	88
Chelan	207	102
Wenatchee	377	105

MAJOR BASIN AND SUB—WATERSHED	WATER EQUIVALENT IN PERCENT OF: LAST YEAR	AVERAGE
SNAKE BASIN		
Snake above Jackson, Wyo.	120	76
Snake above Hiese, Idaho	107	85
Snake above American Falls Res	147	84
Henry's Fork	160	82
Southern Idaho Tributaries	183	86
Big and Little Wood	116	76
Boise	126	71
Owyhee		88
Payette	138	75
Malheur	326	88
Weiser	185	80
Burnt		82
Powder	205	82
Salmon	116	81
Grande Ronde	257	90
Clearwater	185	88
LOWER COLUMBIA BASIN		
Yakima	313	100
Umatilla	437	105
John Day	209	88
Deschutes - Crooked	314	88
Hood		91
Willamette		93
Lewis	457	97
Cowlitz	360	100
PACIFIC COASTAL BASIN		
Puget Sound	311	107
Olympic Peninsula	421	88
Umpqua - Rogue	470	94
Klamath	441	97
Trinity		
CALIFORNIA CENTRAL VALLEY		
Upper Sacramento	240	60
Feather	700	70
Yuba		60
American	460	60
Mokelumne	420	55
Stanislaus	260	55
Tuolumne	130	55
Merced	120	50
San Joaquin	75	45
Kings	100	45
Kaweah	200	45
Tule	180	40
Kern	55	35

Data for California Watersheds supplied by Dept. of Water Resources, and for British Columbia Watersheds by Dept. of Lands, Forests and Water Resources.

Average is for 1943-57 period, except for California which is 1931-60.

Based on Selected Snow Courses determined by Distribution within the Basin, Length of Record and Repetitive Monthly Measurement Schedules.

SELECTED STREAMFLOW FORECASTS APRIL - SEPTEMBER AS OF MARCH 1, 1964

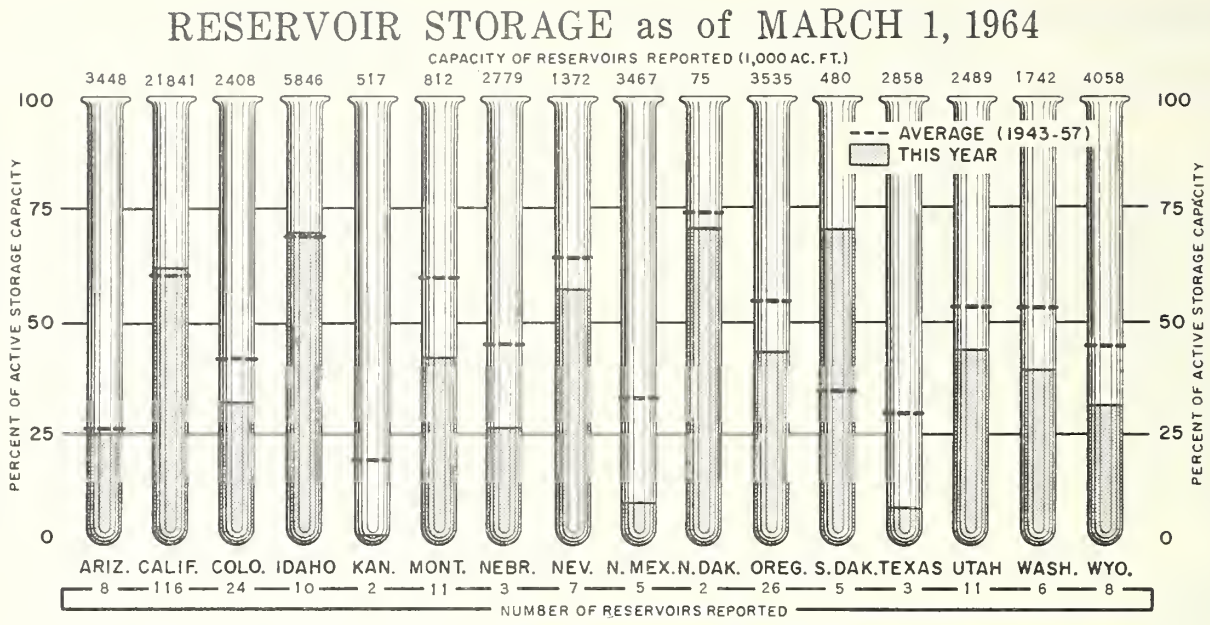
STREAM AND STATION	1000 ACRE-FEET		PERCENT OF AVERAGE
	FLOW 1963	FORECAST 1964	
UPPER MISSOURI			
Clark Fork at Chance, Montana	593	525	85
Gallatin near Gateway, Montana	455	504	110
Jefferson at Sappington, Montana	972	934	87
Madison near Grayling, Montana 1/	430	387	86
Missouri near Zortman, Montana 2/		4100	85
Missouri near Williston, N. Dakota 3/	10687	10250	82
Yellowstone at Corwin Springs, Montana	1935	1800	91
Yellowstone at Miles City, Montana		5540	82
Shoshone below Buffalo Bill Res., Wyoming 4/		680	80
Wind at Dubois, Wyoming		80	80
PLATTE			
Clear at Golden, Colorado 5/	64	100	73
North Platte at Saratoga, Wyoming		478	72
Cache LaPoudre near Ft. Collins, Colorado 6/		130	69
ARKANSAS			
Arkansas at Salida, Colorado 7/	277	190	56
RIO GRANDE			
Rio Grande near Del Norte, Colorado 8/	263	285	58
Rio Grande at Otowi Bridge, New Mexico 9/		280	44
Pecos at Pecos, New Mexico *		47	98
UPPER COLORADO			
Animas at Durango, Colorado		300	63
Colorado at Glenwood Springs, Colorado 10/		1100	71
Colorado near Cisco, Utah	1555	2600	64
Colorado near Grand Canyon, Arizona 11/	3843	5200	57
Duchesne near Tabiona, Utah 12/		70	56
Green near Greendale, Utah 13/	645	1110	75
Green near Green River, Utah 13/	1835	2560	72
Gunnison near Grand Junction, Colorado		830	60
Price near Scofield, Utah 14/		18	45
San Juan near Bluff, Utah 15/	565	515	42
White at Meeker, Colorado		265	79
Yampa at Steamboat Springs, Colorado		220	78
LOWER COLORADO			
Gila near Solomon, Arizona (Mar-May)	126	26	50
Salt at Intake, Arizona (Mar-May)	206	54	27
Verde above Horseshoe Dam, Arizona (Mar-May)	59	29	23
GREAT BASIN			
Bear at Harer, Idaho 16/		165	55
Logan near Logan, Utah 17/	103	110	77
Ogden, Inflow to Pine View Res., Utah 18/ (Mar-July)	86	91	64
Provo at Vivian Park, Utah 19/	119	80	50
Sevier at Hatch, Utah 20/	20	21	43
Sevier near Kingston, Utah	5	5	17
Humboldt at Palisades, Nevada **	216	155	69
Truckee at Farad, California ** 21/	277	200	78
West Walker near Coleville, California **	173	100	68

Forecasts in California provided by Department of Water Resources.
Average is for 1943-57 period except California. California is computed for 1911-60 period.
Forecasts assume average Effective Climatic Conditions from Date Through Snow Melt Season.

SELECTED STREAMFLOW FORECASTS APRIL - SEPTEMBER AS OF MARCH 1, 1964

STREAM AND STATION	1000 ACRE-FEET		PERCENT OF AVERAGE
	FLOW 1963	FORECAST 1964	
UPPER COLUMBIA			
Bitterroot near Darby, Montana	532	545	93
Chelan at Chelan, Washington 22/		1310	102
Clark Fork above Missoula, Montana	1430	1917	106
Clark Fork at Whitehorse Rapids, Montana 23/	10459	13000	93
Columbia at Revelstoke, British Columbia			
Columbia at Birchbank, British Columbia 24/	41100	41800	98
Columbia at Grand Coulee, Washington 24/	58000	64730	96
Columbia at The Dalles, Oregon 24/	86290	99140	93
Flathead near Polson, Montana 23/	5702	6738	90
Kootenai at Wardner, British Columbia			
Kootenai at Leonia, Idaho	8001	7876	88
Okanogan near Tonasket, Washington		1800	94
Spokane at Post Falls, Idaho 25/	1823	2800	86
SNAKE			
Big Lost, Inflow to Mackay Res., Idaho 26/	178	180	105
Big Wood, Inflow to Magic Res., Idaho 27/ (Mar-July)	251	250	81
Boise above Diversion Dam, Idaho 28/	1304	1400	81
Clearwater at Spalding, Idaho	6321	8200	90
Malheur near Drewsey, Oregon	65	65	80
Owyhee Res. Net Inflow, Oregon 18/	271	385	90
Payette near Horseshoe Bend, Idaho 29/	1626	1610	80
Salmon at Whitebird, Idaho	6721	6500	91
Snake near Heise, Idaho 30/	3357	3500	85
Snake at Weiser, Idaho	6212	6200	80
LOWER COLUMBIA			
Cowlitz at Castle Rock, Washington		2965	103
Deschutes at Benham Falls, Oregon 31/		500	83
Grande Ronde near LaGrande, Oregon		200	82
Hood near Hood River, Oregon 32/	250	350	96
Willamette at Salem, Oregon 33/		4855	89
Yakima near Parker, Washington 34/		1830	93
NORTH PACIFIC COASTAL			
Dungeness near Sequin, Washington		175	104
Rogue at Raygold near Central Point, Oregon		875	87
Klamath Lake, Net Inflow, Oregon 35/	572	580	92
CALIFORNIA CENTRAL VALLEY 36/**			
American, Inflow to Folsom Res., Calif.	1755	820	59
Feather near Oroville, Calif.	2653	1240	64
Kaweah, Inflow to Terminus Res., Calif.	332	135	53
Kern near Bakersfield, Calif.	476	170	39
Kings, Inflow to Pine Flat Res., Calif.	1388	510	43
Merced, Inflow to Exchequer Res., Calif.	677	280	45
Mokelumne, Inflow to Pardee Res., Calif.	565	250	52
Sacramento, Inflow to Shasta Res., Calif. 37/	2995	1450	81
San Joaquin, Inflow to Friant Res., Calif.	1413	520	43
Stanislaus, Inflow to Melones Res., Calif.	842	390	53
Tule, Inflow to Success Res., Calif.	65	22	40
Tuolumne, Inflow to Don Pedro Res., Calif.	1435	640	53
Yuba at Smartville, Calif.	1430	720	64

Explanatory Notes on Forecasts Listed on Inside Back Cover.
** April - June Period ** April - July Period*



Average period is 1943-57 except for California, where average period is 1954-63.

Kansas storage is in John Martin and Great Plains Reservoirs in Colorado. Texas storage is in Red Bluff in Texas and Elephant Butte and Caballo in New Mexico. Nebraska storage on North Platte above Kingsley Reservoir in Wyoming and Nebraska.

Reservoir storage data supplied by Bureau of Reclamation, Geological Surveys and water using organizations.

will probably not fill during the snowmelt season. Inflow to Granby will be less than available capacity. Late season shortages can be expected for all smaller tributaries, including the Uncompahgre.

UTAH

Snowfall to date on Colorado River tributaries in Utah is less than half of average and generally comparable to the extremely low snow measurements obtained on March 1, 1963. Several snow courses in southern Utah have a minimum of record March 1 snowpack. Outlook along the Duchesne and Price rivers and their tributaries is poor, except for users under the Strawberry Reservoir. Streamflow prospects are for less flow than actually occurred in 1963.

Storage in the basin for irrigation is much less than usual and slightly less than for a year ago.

ARIZONA

The surface water supply outlook for the principal irrigated areas of Arizona varies from fair to poor. Streamflow from snowmelt is expected to range from 20 to 50 percent of average. Storage in Salt River reservoirs is near average for March, but demands have been greater than inflow. This situation is expected to continue. Reservoir storage, relative to average, will decline. On the Gila and Verde rivers, storage is much less than average. Mountain soil moisture is generally good.

Total water supply, including storage and prospective reservoir inflow, will be about 80 percent of average for the Salt River project. Heavy supplemental pumping will be required on the Salt River project, the San Carlos project, and the upper Gila Valley.

GREAT BASIN

UTAH

Water supplies for interior areas of Utah vary from fair to good on the Bear River and its tributaries and the Cottonwood Creeks in the Salt Lake City area, to poor on the Sevier River drainage. Storage, along with less than average flows, will provide a near adequate water supply for areas served by the Bear, Logan, and Ogden rivers. Less than adequate water supplies are in prospect for upper areas of the Weber.

Shortages comparable to a year ago are in prospect for the Sevier River drainage, Beaver Creek and the Virgin River adjacent to the Great Basin in southern Utah. Near mini-

STORAGE IN LARGE RESERVOIRS — MARCH 1, 1964

BASIN AND NAME OF RESERVOIR	CAPACITY (1000 A.F.)	STORAGE (1000 A.F.)
UPPER MISSOURI		
Boysen	560	295
Buffalo Bill	380	151
Canyon Ferry	2043	1737
Hebgen	385	211
Tiber	1316	646
Belle Fourche	185	133
Keyhole	190	71
Fort Peck	19400	11539
Fort Randall	6100	4333
Garrison	24500	13608
Oahe	23600	8254
PLATTE		
Glendo	786	348
Pathfinder	1011	145
Seminoe	982	222
Colo-Big Thompson (4)	865	396
City of Denver (4)	218	96
ARKANSAS		
Conchas	600	101
John Martin	367	7
RIO GRANDE		
Elephant Butte	2207	158
El Vado	194	2
UPPER COLORADO		
Flaming Gorge	3789	864
Navajo	1709	327
Powell	28040	3119
LOWER COLORADO		
Havusu	619	536
Mead	27207	15090
Mohave	1810	1674
San Carlos	1206	63
Salt River Res. (4)	1755	780
Verde River Res. (2)	322	19
GREAT BASIN		
Bear	1421	724
Lahontan	286	225
Rye Patch	179	79
Sevier Bridge	236	46
Strawberry	270	54
Tahoe	732	350
Utah	1149	289

BASIN AND NAME OF RESERVOIR	CAPACITY (1000 A.F.)	STORAGE (1000 A.F.)
UPPER COLUMBIA		
Chelan	676	222
Coeur d'Alene	238	50
Flathead	1791	1161
Hungry Horse	3428	2297
Kootenay	817	331
Pend Oreille	1155	639
Roosevelt	5072	2792
LOWER COLUMBIA		
Detroit	300	102
Hills Creek	249	111
Lookout Point	337	78
Yakima Res. (5)	1065	458
SNAKE		
American Falls	1700	1317
Arrowrock	287	274
Anderson Ranch	423	242
Brownlee	1427	604
Cascade	653	302
Jackson	847	631
Lucky Peak	278	83
Palisades	1202	912
Owyhee	715	303
PACIFIC COASTAL		
Clear Lake	440	95
Upper Klamath	584	315
Ross	1203	992
Trinity	2500	
CALIFORNIA CENTRAL VALLEY		
Almanor	1036	683
Berryessa	1602	1558
Cachuma	205	166
Casitas	254	46
Cherry Valley	268	78
Don Pedro	290	175
Folsom	1010	508
Hetch-Hetchy	360	136
Isabella	570	164
McClure	281	148
Millerton	521	318
Nacimiento	350	194
Pardee	210	172
Pine Flat	1013	604
Shasta	4500	3161

Reservoir Storage Data Provided by Bureau of Reclamation, Corps of Engineers, Geological Survey, and water using organizations. Data from California and British Columbia provided by Department of Water Resources and Department of Lands, Forests and Water Resources, respectively.

mum of record snowpacks are now present on southern and south central Utah watersheds. Lack of reservoir storage complicates the prospective lack of streamflow.

NEVADA

With limited February snowfall, water supply outlook has declined slightly from February 1. Irrigation water users that derive all or part of their supply from reservoirs have reasonably ample water in prospect. Users on smaller tributaries with no storage have a much less favorable water supply outlook.

Streamflow forecasts for east slope of Sierra streams range near two-thirds of average. Southern Nevada streamflow will be less than 50 percent of average. Mountain and foothill soils are relatively wet throughout the northern and central sections of the state.

COLUMBIA BASIN

After a record increase in snowpack during January over the western section of the Columbia Basin, February snowfall was generally less than average. Seasonal snowpack to date ranges from about 110 percent of average in the Cascade Mountains of Washington to about 70 percent of average on the Snake River tributaries in western Idaho. Most snow measurements were in the range of 90 to 100 percent of average as of March 1. Snowfall in early March has added to the streamflow prospects, possibly restoring the outlook as of February 1.

Based on March 1 snow surveys, the forecast for the Columbia at The Dalles, Oregon is for about 99,000,000 acre-feet flow for the April-September 1964 period, or about 93 percent of average. This represented a drop of near 10 percent during February and indicates the relative change in outlook over the entire basin.

Outlook for both irrigation and power is good. Stored water for the principal irrigated areas is near average, and prospective inflow should bring reservoirs to the usual operating levels by the start of the heavy water demand season. Power reservoirs will fill.

BRITISH COLUMBIA

The Water Resources Service of the Department of Lands, Forests and Water Resources reports that the March 1 snow survey showed that, with one exception, mountain snow on British Columbia watersheds can be classified in the average to above-average category. The one exception is the Lower Coastal snowpack, which is the highest of its period of record. Falling into the above-average category are the Nechako, Skagit and Okanagan-Similkameen snowpacks, with Kootenay, Columbia, Thompson, and Middle Fraser snowpacks classified as average.

Assuming that future precipitation follows its normal trend up to and during the runoff period, a good supply of snowmelt water is assured in all regions of the Province.

MONTANA

The flow of Columbia River tributaries in western Montana is expected to be near average except for the Kootenai, where forecasts are for 90 percent of average. Flows will be adequate for irrigation and power requirements. Snowpack at higher elevations is near the average for March 1. Snow at valley elevations has been relatively high during January and February.

IDAHO

The water supply outlook for Idaho took a significant drop during the month of February. Snow water contents on the high mountainous areas fell from 10 percent to 40 percent in relation to normal. Precipitation in the valleys took a similar drop, and prevailing temperatures were below normal for the month. Forecasts of streamflow throughout Idaho now vary from 55 percent of normal on the Bear River at Harer to 108 percent for the Big Lost River at Howell Ranch. In general, the April through September streamflow for the major rivers in the state are forecast to flow 10 percent to 20 percent below an average year. Snowfall has continued to follow an unusual pattern this season. Valley and foothill areas have an extremely heavy snow cover for this time of the year, while the high mountainous terrain has a snowpack well below normal.

Soil moisture sites indicate unfrozen soils beneath the snowpack throughout the state. The unfrozen soil can slow down runoff by absorbing melting snow or rain.

Reservoir-stored water throughout the state is generally good, although in several cases, slightly below normal for this time of the year. These exceptions are the Bear Lake, Oakley and Owyhee reservoirs. Good streamflow forecasts for the Owyhee River indicate one of the best situations occurring there in the past five to ten years. The Bear River is below normal in stored water and has an unusually low inflow forecast.

OREGON

A clear, cool February with near record low precipitation has slightly dimmed the water supply outlook for 1964. Although the water supply picture for most of Oregon remains good, stored water in a few reservoirs is short of the amount needed to fully meet needs throughout the crop season.

Water content of the mountain snowpack increased only slightly during February. Statewide, March 1 snowpack is 91 percent of average this year as compared to an extremely low 30 percent of average on March 1, 1963. Mountain soils are wet. Very little snowmelt water will be required to replace soil moisture deficits. Storage in Oregon reservoirs is about three-quarters of average.

Storage and prospective streamflow will be adequate to meet usual demands except for areas served by McKay Reservoir near Pendleton and Clear Lake near Maupin.

Streamflow forecasts range from about 80 percent of average on the Deschutes and its tributaries to slightly above average for streams in the interior basin of south central Oregon.

WASHINGTON

Even with deficient snowfall during February, the water supply outlook for irrigation and power remains good. The heavy snowfall during January accounts for most of the seasonal snowpack which still exists in high mountain areas. As of March 1, total snow accumulation ranges from about 120 percent of average on streams of the Puget Sound watershed to as low as 75 percent of average on the Ahtanum, a low elevation tributary to the Yakima. Reservoir storage is generally below average, but prospective streamflow will be adequate to fill reservoirs in principal irrigated areas. Mountain soils are wet. Any shortages that may develop from a deficiency in late season snowfall will be limited to small areas in the southeastern section of the state.

CALIFORNIA

The California Department of Water Resources, coordinating agency for snow surveys and water supply forecasting in California, reports that prospects of a normal water supply in California during this water year have been impaired by one of the driest Februarys of record. March 1 data from throughout the state shows a significant letdown in the water supply situation from that of a month ago. The stored water situation remains good, with reservoir storage in California normal for this date. This favorable condition exists although lack of February rains, coupled with warm, dry winds, has resulted in earlier than usual irrigation demands in most areas. The efficient use of stored water this coming spring and summer will be the general mood of operations throughout California, with possibly some curtailment in irrigation in order for some areas.

Precipitation for February throughout California was either non-existent or light. The most significant feature of February precipitation was its near record deficiencies in every river basin throughout the state. Less than 60 of approximately 300 precipitation stations for which data were received had greater than 10 percent of average rainfall for the month. Precipitation in California has reached not over quite 7 percent of normal. Zero amounts were recorded at many stations during February, not only in the Central and South Coastal areas and in the Central Valley, but even in Sierra watersheds. North Coastal areas, which usually receive significant amounts of rainfall during winter months, received only 10 percent of normal amounts during February.

Snowpack measurements were obtained at 165 snow courses and 68 aerial snow depth markers throughout the state on or about March 1. In general, California snowpack water content decreased from February 1 levels, although snow courses in the watersheds of the Sacramento Valley showed minor gains. The March 1 average snowpack in California was 60 percent normal. All hydrographic areas in the state were within 5 percent of the over all state average.

Last year the snowpack in California went from the lowest of record at this time to above average by the end of the season. A repeat performance this year would be welcome.

Unimpaired runoff from major streams in California echoed the month's meager precipitation. Streams in the North Coastal area averaged less than 45 percent of normal. Streamflows in the other coastal areas of the state rank with the lowest February flows of record, ranging between 5 and 15 percent of average. Runoff in the Central Valley and Lahontan area during the past month was 35 percent and 70 percent of average, respectively.

During the period October to March runoff from major streams in California was 80 percent of average. The Lahontan area, with 120 percent of average runoff continues to have the highest percentage of runoff in the state. Runoff from the remaining major hydrographic areas is below normal, varying from 90 percent of average in the North Coastal area to 35 percent of the San Francisco Bay area. The drought condition in southern California continues with unimpaired runoff in South Coastal areas for the October to March period, only 20 percent of average.

Water content in California reservoirs is average for March 1. This average of reservoir storage is based on data received for 110 reservoirs in the state, which have a combined usable capacity of over 21,800,000 acre feet. The total water in storage on March 1 was about 13,167,000 acre feet, which is over 62 percent of the combined capacity. This is about 100,000 acre feet less water than was stored in these reservoirs one year ago.

EXPLANATION of STREAMFLOW FORECASTS

1/ Observed flow adjusted for change in storage in Hebgen Lake. 2/ Observed flow adjusted for change in storage in Canyon Ferry and Tiber reservoirs. 3/ Observed flow adjusted for change in storage in Canyon Ferry, Tiber, Fort Peck, Buffalo Bill, and Boysen reservoirs. 4/ Observed flow adjusted for change in storage in Buffalo Bill Reservoir plus Heart Mt. Diversion. 5/ Observed flow minus diversion through Jones Pass Tunnel.

6/ Observed flow minus diversions from North Platte, Colorado, and Laramie rivers plus measured diversions for irrigation and municipal use above station. 7/ Observed flow adjusted for change in storage in Clear Creek, Twin Lakes, and Sugar Loaf reservoirs minus trans-mountain diversions through Busk-Ivanhoe and Twin Lakes tunnels and Ewing, Fremont, Wurtz, and Columbine ditches. 8/ Observed flow adjusted for change in storage in Santa Maria, Rio Grande, and Continental reservoirs. 9/ Observed flow adjusted for changes in storage in reservoirs listed in (8) plus Terrace, Sanchez, Platoro, and El Vado reservoirs. 10/ Observed flow adjusted for changes in storage in Granby Reservoir plus diversions through Adams Tunnel and Grand River Ditch.

11/ Observed flow adjusted for changes in storage in Flaming Gorge, Navajo, and Lake Powell. 12/ Observed flow plus diversion through Duchesne Tunnel. 13/ Observed flow adjusted for changes in storage in Flaming Gorge and Big Sandy reservoirs. 14/ Observed flow adjusted for change in storage in Scofield Reservoir. 15/ Observed flow adjusted for change in storage in Navajo Reservoir.

16/ Observed flow. 17/ Observed flow plus Utah Power and Light Tailrace and Logan, Hyde Park, and Smithfield canals. 18/ Record computed by Bureau of Reclamation. 19/ Observed flow adjusted for change in storage in Deer Creek Reservoir, minus diversions through Duchesne Tunnel and Weber-Provo Canal, plus diversion through Salt Lake Aqueduct. 20/ Observed flow.

21/ Observed flow exclusive of Lake Tahoe and adjusted for change in storage in Boca Reservoir. Forecast by Truckee Basin Water Committee. 22/ Observed flow adjusted for change in storage in Lake Chelan. 23/ Observed flow adjusted for change in storage in Flathead and Hungry Horse reservoirs. 24/ Observed flow adjusted for change in storage in any or all of the following reservoirs above the station: Kootenay, Hungry Horse, Flathead, Pend Oreille, Coeur d'Alene, F. D. Roosevelt, Lake Chelan, Noxon, and Brownlee; and pumping from F.D.R. Lake. 25/ Observed flow adjusted for change in storage in Coeur d'Alene Lake plus diversions to Spokane Valley Farms and Rathdrum Prairie canals.

26/ Observed flow adjusted for change in storage in Mackay Reservoir plus diversion in Sharp Ditch. 27/ Combined flow of Big Wood near Belleview and Camas Creek near Blaine. 28/ Observed flow adjusted for changes in storage in Lucky Peak, Anderson Ranch, and Arrowrock reservoirs. 29/ Observed flow adjusted for changes in storage in Cascade and Deadwood reservoirs. 30/ Observed flow adjusted for changes in storage in Palisades and Jackson reservoirs.

31/ Observed flow adjusted for changes in storage in Crane Prairie, Wickiup, and Crescent Lake reservoirs. 32/ Adjusted to natural flow. 33/ Observed flow adjusted for changes in storage in Lookout Point, Detroit, Cottage Grove, Dorena, and Hills Creek reservoirs. 34/ Observed flow adjusted for changes in storage in Keechelus, Kachess, Cle Elum, Bumping, and Tieton reservoirs, plus diversions by Rosa, New Reservation, Old Reservation, and Sunnyside canals. 35/ Flow records provided by PP&L and USBR.

36/ All forecasts are for unimpaired streamflow except Kaweah River. 37/ Not corrected for upstream impairments. All other forecasts are for observed flow.

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